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Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☐ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☒ | ☐ | The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ | A description of all covariates tested |
| ☒ | ☐ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ | A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ | For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☐ | ☒ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ | Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection

Data analysis

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

The data and R code that support the findings of this study are available in Dryad (<https://doi.org/10.5061/dryad.d51c5b0f9>)

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	NA
Reporting on race, ethnicity, or other socially relevant groupings	NA
Population characteristics	NA
Recruitment	NA
Ethics oversight	NA

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	Comparative study for evolution of the cooperative breeding system of cichlids in Lake Tanganyika. Data used in the study includes both field-collected data and data obtained from literature surveys. These data were analyzed by BPMM, ASR, and PPA.
Research sample	Data include matured male having breeding territory and females with eggs in ovaries sampled in Lake Tanganyika. Cooperative breeding systems have only been reported from cichlids in Lake Tanganyika. Therefore, the perspective of the study was the Lake Tanganyika cichlids. All sampling specimens were matured breeding females and males.
Sampling strategy	These data were mainly from obtain from fishermen in local fish market. Some fish species were sampled by SCUBA diving. To compensate for the small sample size, a survey of specimens held in museums was also carried out.
Data collection	Buying at fish markets, sampling using by SCUBA, and museum survey (for egg size, clutch size, and female body size). literature survey (for social system). We also gain data from public database, FishBase.
Timing and spatial scale	Sampling began in 2014. If a female was found with mature eggs, e.g. at a fish market, observers bought them. Sampling took place irregularly and continued until 2024. Similarly, dive sampling was carried out when mature individuals were found. Sampling began in 2014. If a female was found with mature eggs, e.g. at a fish market, observers bought them. Sampling took place irregularly and continued until 2024. Similarly, dive sampling was carried out when mature individuals including male were found.
Data exclusions	The eggs of some female individuals were immature. In this case, we removed this from our data.
Reproducibility	We had not carried out any experiments. Results can be reproduced using by uploaded dataset with R code on Dryad.
Randomization	NA
Blinding	Egg measurements were carried out with the blinded to species information.

Did the study involve field work? ☒ Yes ☐ No

Field work, collection and transport

Field conditions	The study was conducted in Lake Tanganyika, Republic of Zambia. The study period included both dry and rainy seasons.
Location	The study was conducted mainly in southern end of Lake Tanganyika (Mpulungu city).

Access & import/export

All data of this study are available at dryad (<https://doi.org/10.5061/dryad.d51c5b0f9>). Our field research in Lake Tanganyika was conducted with permission from the Zambian Ministry of Agriculture, Food, and Fisheries and complied with the current laws in Zambia.

Disturbance

We took care to ensure that the sampling did not affect endemic ecosystems. Purchasing fish already caught by local fishermen reduced the number of fish to be sacrificed. SUCUBA dive sampling was also carried out by catching female individuals with mature eggs, judging from the bulge in their abdomen.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Animals and other research organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research, and [Sex and Gender in Research](#)

Laboratory animals

NA

Wild animals

In total, data were obtained from 155 females and 351 males of 39 species (n = 14 cooperative and n = 25 non-cooperative breeders).

Reporting on sex

Sexes of specimens were determined by dissecting the gonads.

Field-collected samples

Data bias of sexes of specimens is mentioned in the discussion as well as in the methods.

Ethics oversight

Captured fish by SCUBA diving were sacrificed by overdose with anesthetics (MS-222, Wako Pure Chemical Industries). All experimental protocols were approved by the Animal Care and Use Committees of Osaka City University and adhered to the ASAB/ABS guidelines for the treatment of animals in behavioral research. Our field research in Lake Tanganyika was conducted with permission from the Zambian Ministry of Agriculture, Food, and Fisheries and complied with the current laws in Zambia.

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Plants

Seed stocks

NA

Novel plant genotypes

NA

Authentication

NA